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MICROMINIATURE DEVICES FOR ELECTRONICS

Item of Interest

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MICROMINIATURE DEVICES FOR ELECTRONICS

SOURCES: 1. Kil'metov, R. S., A. V. Kovalev, and Ye. B. Mekhantsev. First scientific and technical conference of schools of higher education on the microminiaturization of radioelectronic devices. Izvestiya vysshikh uchebnykh zavedeniy. Radiotekhnika, v. 5, no. 4, 1962, 538-539. (S/142/62/000/004)

2. Yermolayev, Yu. P. Prospective and rational structures of printed resistors in microminiature equipment. Izvestiya vysshikh uchebnykh zavedeniy. Radiotekhnika, v. 5, no. 4, 1962, 469-475. (S/142/62/000/004)

The First Scientific and Technical Conference of Schools of Higher Education on the Microminiaturization of Radioelectronic Devices was held in March 1962 [1]. Five hundred and thirty representatives of schools of higher education, scientific research institutes, and industrial enterprises participated in the conference, at which 60 papers were presented. Among the topics discussed at the conference were the following: the future of the design and production of microminiature devices (L. N. Kolesov and F. Ye. Yevteyev); the design and preparation of solid-state micromodules (V. G. Adamchuk and P. Ye. Fomichev); limitations in the microminiaturization of electronic elements (L. N. Kolesov and G. P. Sherova-Ignat'yeva); electrochemical methods of obtaining contacts (rectifying and nonrectifying) of complex configuration (V. M. Kochegarov, V. A. Slovina, D. I. Zaks, and V. D. Samuylenkova); the theoretical study of flat inductance coils placed between two nonconductive ferromagnetic media and the structure and preparation of film-type microinductors and ferromagnetic films (K. L. Afanas'yev, L. S. Shibanov, Yu. P. Pasichnyy, and V. Ye. Prozorovskiy); resistors for solid-state modules (D. A. Sechenov); the selection of dielectric materials and their electrophysical properties, and recommendations for obtaining dielectric films on a base composed of titanium dioxide, a strontium-bismuth-titanium system, and barium titanate with specific capacitance at 100,000 $\mu\mu f/cm^2$ (K. A. Vodop'yanov); methods for obtaining inductive elements for solid-state micromodules and the results of studying the distributed capacitance of p-n junctions as active or passive circuit elements (I. P. Stepanenko, V. I. Vaganov, L. N. Patrikeyev, and Yu. P. Radionov); and factors affecting the production of accurate microminiature resistors, the electrical strength of microminiature resistors, and prospective and rational structures of printed resistors in microminiature equipment (Yu. P. Yermolayev).

[The last topic (published in Source 2) was felt to be of particular interest. It will therefore be examined in some detail.]

The occurrence of local overheating in microminiature printed resistors results in damage to the resistor or instability in its operation. In the curved section of long strip-type printed resistors deposited on a thin base, the current lines shift to the inner radius of the curve. This shifting increases when the ratio (k) of the outside radius to the inside radius increases and when the angle through which the resistor is bent is increased. By means of formulas, which have been supported by experimental measurements, it is shown that with an infinitely thin base and with $k = 10$ and with a 180° bend, maximum local heating is 14 times higher than occurs in the heating of a straight section of the resistor.

Several methods are proposed for the elimination of this local overheating: 1) by making holes in the resistive film near the inner surface (Fig. 1,a); 2) by placing low-resistance sectors over the curved section, as shown in Fig. 1,b); 3) by using a conductive jumper instead of a curved resistor section (Fig. 2,a) (this method introduces additional junctions); 4) by placing the curved section of the resistor over a conductive film (Fig. 2,b) in order to obtain a better structure as compared with the proposal shown in Fig. 2,a; and 5) by increasing the width of the curved section (Fig. 2,b). The last method cannot be used with thin bases because the condition near the inner surface does not change.

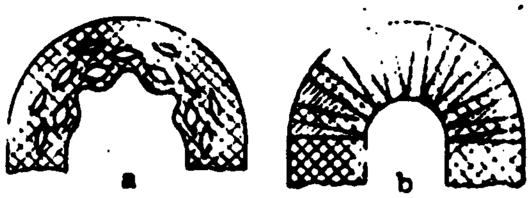

Fig. 1

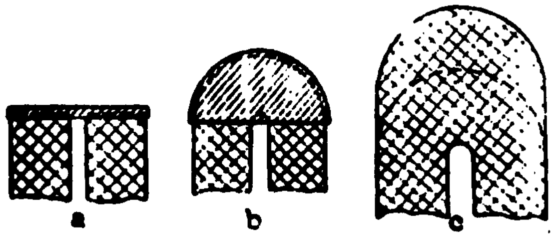

Fig. 2

In straight strip-shaped resistors, the overheating of the middle part increases with strip width. It was established experimentally that the specific dissipated power of the 2-mm wide film resistor on a 1-mm-thick pertinax base is approximately four times higher than that dissipated by a 10-mm-wide resistor. Thus, for reducing overheating in the middle part of a wide resistor, it is proposed that the resistor width be divided into 2 to 4 strips. For adjustment of precision printed resistors, the author proposes that the resistive film in the middle part near the contact be removed, as shown in Fig. 3,c. The configurations shown in Fig. 3, a and b, are not recommended. It is also shown that the temperature of the wide and short printed resistors is higher in the middle part and is lower at the corners of the resistive film. The

resistor shapes shown in Fig. 4,a and b, are recommended for more equal temperature distribution.

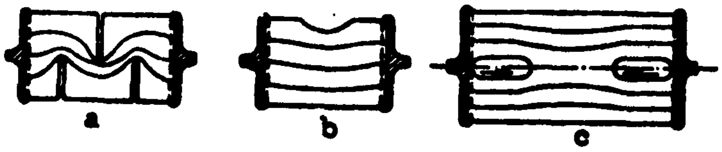

Fig. 3

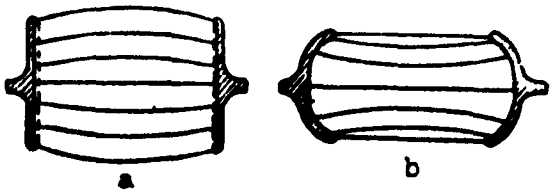

Fig. 4